A class of high order compact schemes with good spectral resolution for aeroacoustics

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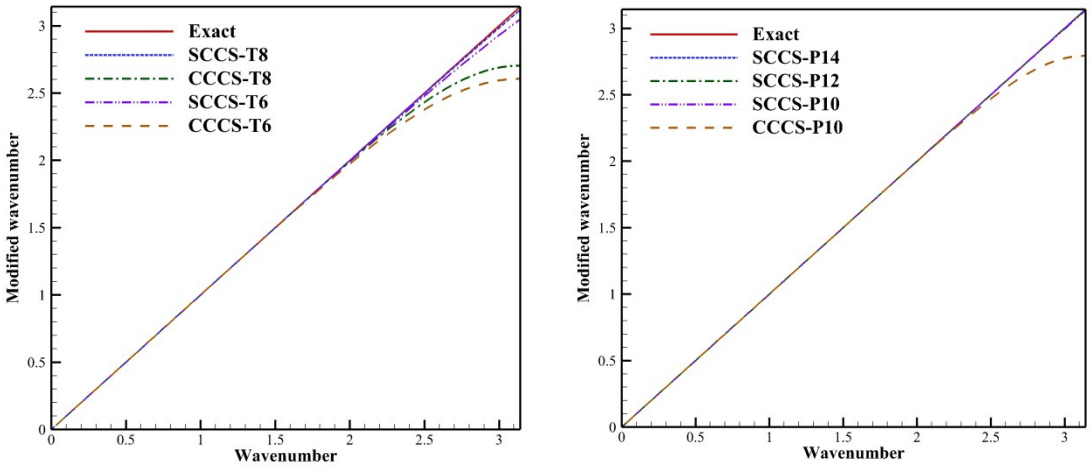
Abstract: In this paper, we design a class of linear compact schemes based on the cell centered compact scheme of Lele[1]. These schemes equate a weighted sum of the nodal derivatives of a smooth function to a weighted sum of the function on both the grid points and the cell-centers. Instead of using a compact interpolation to compute the values of cell-centers, the physical values on both the grid points and half-grid points are directly computed with the same scheme[2-3]. Through systematic Fourier analysis and numerical tests, we observe that the schemes have the property of high order, high resolution and low dissipation and are ideal for the simulation of aeroacoustics. Figure 1 is the modified wavenumber of strongly central compact schemes(SCCS). Figure 2 shows the numerical solutions of the CAA benchmark problem[4] appear to agree very well with the exact solutions.

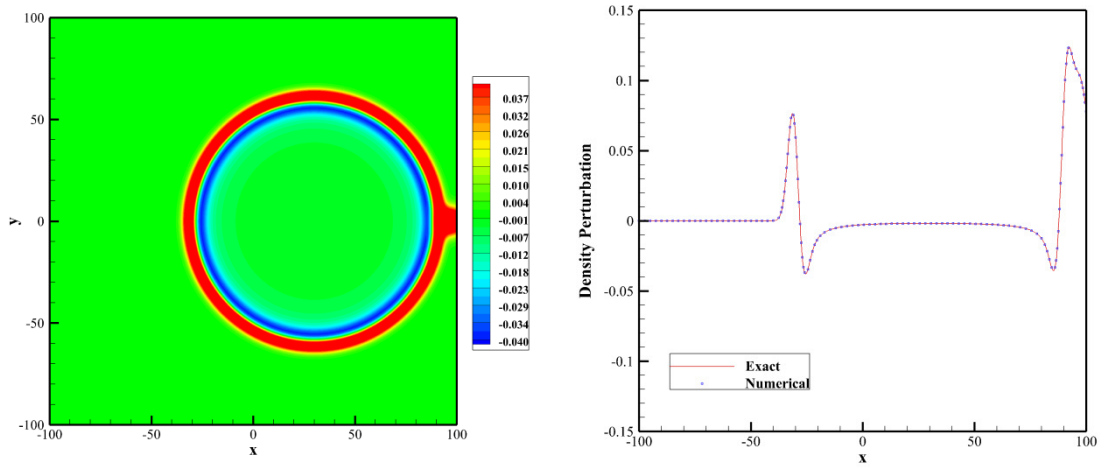
Keywords: Compact scheme, High order, High resolution



(a) The tridiagonal strongly central compact schemes(SCCS)

(b) The pentadiagonal strongly central compact schemes(SCCS)

Figure 1: Modified wavenumber of strongly central compact schemes(SCCS)



(a) Contours of density at t=60

(b) Comparison of density with exact solution along y = 0 at t=60

Figure 2: Numerical solutions of the CAA benchmark problem[4] by SCCS

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